

I. UPPER MANISTEE RIVER WATERSHED

A. THE WATERSHED

The Upper Manistee River watershed is located in the northwestern portion of Michigan's Lower Peninsula. It has a drainage area of 590 square miles. The watershed includes parts of five counties: Antrim, Otsego, Crawford, Kalkaska and Missaukee. The mainstream is approximately 78 miles long and originates in southeast Antrim County (approximately six miles from the village of Alba), at an elevation of 1,250 feet. From this point the river meanders southerly until it reaches a point about six miles west of Grayling, in Crawford County. Here, the river turns and meanders southwesterly until it reaches the planning area boundary of the Wexford/Missaukee County Line. The Manistee continues flowing southwesterly until it ultimately discharges to Manistee Lake and then Lake Michigan at the City of Manistee. Along the way, the river is fed by large tributaries such as the North Branch as well as many other smaller tributaries. The river has a total drop in elevation from the headwaters to the planning area boundary of 315 feet, an average of four feet per mile.

B. CLIMATE

The watershed offers a climate typical of Michigan's "north country" that is strongly affected by Lake Michigan. The warm days and cool nights offer a pleasant summer haven for residents and tourists. Winter's abundant snowfall provides excellent conditions for skiing, snowmobiling, and other winter sports.

Weather data for the Manistee basin indicates a record high of 107 degrees F and low of -45 degrees F, both recorded in the Grayling-Fife Lake Area. Mean January and July temperatures are 17.4 and 58.7 degrees F, respectively. The average low temperature for January is 10.4 degrees F, while the average high temperature for July is 80.2 degrees F. The average length of growing season is 121 days.

The summer season yields 34 percent of the annual precipitation, with another 30 percent occurring during the fall. The low occurs in February with an average monthly yield of 1.44 inches. Annual precipitation averages 32.04 inches.

C. TRANSPORTATION AND AREA GOVERNMENT

One major US highway, US 131, currently crosses the western end of the Upper Manistee watershed. This is a limited-access highway from southwest Michigan to just south of Cadillac. From Cadillac, it becomes a two-lane highway that crosses the Manistee River mainstream north of Manton, downstream of the planning area. A new limited-access highway is proposed to replace this section of US-131 in the future.

Two State highways traverse the river or tributaries in the watershed, including M-72 in Kalkaska County and M-66 in Kalkaska and Missaukee counties. In addition, many paved and unpaved year-round county roads, as well as seasonal roads and two-tracks, are present in all counties.

Commercial airline service is available at Traverse City, west of the watershed. Although there are rail lines in the watershed, no passenger rail service is available.

The watershed includes portions of five counties and 20 townships, although only 17 townships have any appreciable stream mileage. There are no incorporated municipalities in the Upper Manistee River watershed.

D. GEOLOGICAL HISTORY

The predominating historical influence on the Manistee River is, of course, its geologic background. The unique conditions left by the Pleistocene glaciers that advanced and retreated from this portion of Michigan's Lower Peninsula provided the ecological framework for the plant and animal communities in the watershed. Many of the characteristics that make this river system worthy of consideration for Natural River designation are directly attributable to the porous nature of the glacial outwash deposited between the Lake Border and Port Huron Moraine.

Meltwaters pouring off the Port Huron ice sheet carved out two large discharge channels running east and west. The present-day Manistee River "under-fits" the westerly channel, resulting in the appearance of a large river valley and delta formed by a relatively small river. The Au Sable River occupies the easterly channel, discharging to Lake Huron at Oscoda.

E. HISTORICAL HUMAN INFLUENCES

Earliest archaeological evidence of human inhabitants dates to the Paleo-Native American period, over 10,000 years ago. These were nomadic people who followed herds of game animals. By 500 BC, there was a change to a more sedentary lifestyle as people established camps for a season or more and agricultural practices were developed.

Forty-three archeological sites are listed in the watershed (Table 1). Actual scholarly study of the Manistee River archaeology has been limited. Numerous burial mounds associated with the Late Woodland Period are located along the riverbanks. The majority of sites excavated to date are relatively small seasonal villages used during the harvest of fish, game and plants.

Numerous sites were discovered during a 1965 archaeological investigation of the area between Sharon (Kalkaska County) and Sherman (Wexford County). These included Native American burials, village locations and transient campgrounds. Most were dated between 8,000 BC and 500 AD.

Prior to European exploration in the first half of the 1600's, Native American tribes including the Ottawas, Potawatomis and Chippewas used the Manistee River watershed and its resources. The Native American "Manistee River" name has several documented meanings, including "river at whose mouth are islands," "river with white bushes along the banks," "crooked river," and "spirit of the woods."

Many area tribes intentionally burned certain areas in the watershed to manage habitat and vegetation types. This activity likely stopped near the time of the first European exploration when French explorers came to the region, primarily motivated by the fur trade (Jean Nicolet, in 1634, is thought to be the first white man to visit northern Michigan). The tribes built no large permanent settlements, but traveled to stations throughout the Manistee River watershed to hunt, fish and gather the region's rich plant resources. They continued these activities throughout the French and British regimes in Michigan, spanning the years roughly between 1634 and 1812.

In 1760, the English took control of northern Michigan from the French. The newly formed United States of America laid claim to the former French and British colonial territories in the Great Lakes region in 1776. A January 1805 Act of Congress provided for the organization of the Territory of Michigan. Ottawas, Chippewas and Potawatomis joined with Tecumseh and the British in an unsuccessful effort to repel the U.S. during the War of 1812. On October 13, 1813 General Lewis Cass was appointed Civil Governor of Michigan Territory. He created the first county, Michilimackinac, bounded on the east by the Cheboygan River, the south by the Manistee River, the west by the Manistique River, and by Canada on the north.

In 1821 and again in 1836, Ottawa bands living along the Manistee ceded title to their lands to the United States. By 1830, the Government Land Office survey of Michigan had begun, creating the township, range, and section system we now have. Prior to this time, the Manistee River watershed was still relatively undeveloped by non-natives. In 1837 came statehood for Michigan and in 1840, the creation of counties as we know them today.

Non-natives were late in developing the watershed. The interior portion of the watershed was not logged until after 1870, as the river was choked with logjams. The Manistee River contained so much wood that it was rare to find a long stretch of open water. Prior to construction of the Manistee Bridge (now the M-37 bridge north of Sherman, downstream of the planning area), the only river crossing was via a log jam so solid horses and livestock could cross. Logging company crews clearing the river for log drives did not reach Sherman until 1870.

A review of H.R. Page's 1885 "History of Manistee County" gives a glimpse of the characteristics of the river in pre-European settlement days. In 1869, an exploration of the Manistee River was made under the direction of the ironically named River Improvement Company. A.S. Wordsworth, leader of the survey party, wrote an account of that survey, an excerpt of which follows:

"September 18th, in two canoes, so light we could carry them upon our shoulders, we commenced descent of the Manistee, from Section 18, T28N, R4W [near Deward in the upper reaches of the planning area]. The spring sources of this stream are in hardwood timber land, but changing to pine land near the south boundary of T29N; thence for sixty miles on either bank is good pine land, or pine plains, some cork pine, but mostly Norway pine; ...the Manistee decidedly floatable for saw logs from Section 18, T28N, R4W: stream fifty feet wide, well defined banks; extreme freshet rise two feet.... Soon after crossing the western boundary of Range 6 west [Sharon area], we encountered the first flood jam worthy of notice upon the river. This jam is 20 rods [330 feet] up and down the stream: estimated expense of removal, \$40 per lineal foot or \$800.

"These jams date back in buried centuries. As evidence, we find deep-worn trails around them, where Indians have dragged their canoes; also soil accumulations from fallen leaves and freshet of the stream, with forest growth. Cutting to the heart of a cedar twenty inches in diameter, growing over the center [of the log jam], I counted 160 years growth.

"The eleven flood jams of the Manistee [that the party encountered] have a lineal extent, by the thread of the river, of 263 rods [4,340 feet]. Expense of working a channel through them, thirty feet wide; in round numbers, \$10,000; wing jams and snags, etc., etc., say \$5,000; in all, \$15,000. One mile below the last named flood jam, commence lumbermen's rollways; thence downstream they become noticeable features of the river.

"Two miles down the stream, we encountered a jam of floating sawlogs of one and one-half mile extent, over or around which we were compelled to drag or carry our canoes, and pack our camp

'fixens,' and rock, clay, sand, gravel and soil specimens. At the foot we found a force of nine men at work breaking the jam.

"We here see the last of the 'Grayling,' a fish allied to the speckled trout, and called by the residents, the 'Manistee' fish. They are in great abundance near bend waters; they feed, at this season, upon a small, white miller, and readily take a fly-hook, often darting above the surface to secure their prey. Their average length is ten inches, weighing from six to twelve ounces. Hundreds can be taken with a single hook, in a day. They are the "grayling" of English and Scotch waters.

"The Manistee River has been long known as one of the most remarkable streams in the Northwest in this, that it never floods, seldom freezes, and is never affected by droughts. The secret of these singular features of the river is found in the fact that it is fed with springs which flow into the stream from its banks every few rods, so that it is safe to say there are more than a thousand spring streams that bubble up and empty their pure waters into the river within fifty miles of Manistee. These streams vary in size from a small rill to a good mill stream. Everywhere along the banks of this beautiful river they boil out and bubble up in their crystal beauty, affording water as pure and sweet as any in the world; and this probably accounts for the great abundance of the grayling fish, which is sweeter meated and every way as gamey as the brook trout."

The onset of the logging era began what may have been the greatest human influence on the river system. Large-scale removal of logs changed fisheries and wildlife habitat and the very character of the area. The loggers not only removed numerous logjams and large woody debris from the stream channel, they rolled logs down the banks (the "rollways") and drove them to market in the spring. Without trees to stabilize the exceptionally sandy soils in the area, huge amounts of sediment entered the river. Although erosion and sediment transport are natural functions in a stream environment, such a massive artificial influx of additional sediment often overwhelms natural stream processes. Once in the stream, the increased sediment load begins to affect the aquatic environment. The deposition of sand and sediment along the stream bottom causes the stream to overflow its banks. As this occurs, sediment begins to flow laterally and cover the edges of the stream. As the sediment builds up, the stream channel begins to braid, forming several channels in a wider, flatter area. Stream temperatures rise, and fish lose valuable habitat for feeding, resting, and spawning.

These effects can be observed on the Manistee River. The upper stretches in the Deward Tract are beginning to recover from the logging era. However, just downstream from Cameron Bridge, the river begins to widen, has a lower gradient and becomes braided. This sandy braided condition is at least partially the result of sedimentation following the de-vegetation of the uplands surrounding the river.

From the early 1840's to 1940, the lifestyles of the Native American people, and thus their influence on the river, underwent several changes due in part to the increased presence of non-natives. After the 1855 Treaty of Detroit, Ottawas formed new permanent agricultural settlements south of the watershed. By the late 1870s, many Ottawas had sold or lost title to their lands, and migrated to the outskirts of newly formed towns or more isolated areas, still primarily relying on the natural resources of the area to earn a living.

In 1900, the Manistee River was proclaimed Michigan's last great "un-harnessed" river, capable of producing 40,000 horsepower of electricity. Stronach Dam on the Pine River, the major tributary to the lower Manistee, was the first hydroelectric dam on the system, being completed in 1912. Stronach Dam originally supplied power to the City of Manistee. The Michigan Railway Company

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acquired the project around 1915, with the intention of supplying power to a proposed electric railway. Consumers Power Company acquired the project in 1917 after the electric railway plans were abandoned and operated the plant until July 8, 1953.

Downstream of the planning area, Tippy Dam was completed and began producing power in 1918 and Hodenpyl Dam in 1925. Tippy Dam was then called Junction Dam, being at the confluence of the mainstream and South Branch Manistee, as the Pine River was formerly called. Fortunately, the Upper Manistee escaped the immediate effects of large hydropower facilities.

The construction of these and other smaller dams had a great influence on the river system. Dams have a variety of effects on river ecosystems. They influence flow patterns and alter channel cross-sections. They fragment the river system, blocking drift and migration by fish and other aquatic organisms. They change river temperatures (making some areas unsuitable for native fish to survive), increase evaporation and reduce stream flow, disrupt sediment and woody debris transport and modify water quality. They can also cause significant direct fish mortalities. Impoundments also result in a loss of riverine habitat and the subsequent changes in fish and aquatic invertebrate populations. The Manistee River shows all of these effects.

The onset of the “modern age” saw a restructuring of the economic and social order in many communities, native and non-native, and with it new influences of the watershed. With lesser reliance on the natural resources of the area for subsistence, increased agricultural, urban and residential uses began to have a greater impact.

From 1933 to 1942, enrollees in the many Civilian Conservation Corps (CCC) camps in the Upper Manistee River watershed had a significant impact on the river system. Reforestation efforts by the corps helped hasten recovery from the devastating logging activities of the recent past. Many erosion control and habitat structures were constructed during this time. The CCC also planted millions of fish in area streams, fought forest fires and built many area campgrounds.

Oil and gas exploration also began in the watershed in the 1930's. The majority of early development occurred in Osceola, Lake, Crawford, Kalkaska and Missaukee counties during the 1940's through early 1960's. The Niagaran Reef oil development began in the late 1960's, with the majority of the activity occurring between 1969 and 1986. Several thousand wells were drilled throughout the watershed. Deep gas exploration occurred sporadically in the watershed beginning in the 1980's. Shallower Antrim gas development began in 1987, and has been widespread in the years since. The potential for additional widespread Antrim development continues to exist throughout the watershed. The Manistee River watershed has produced more oil and gas than any other watershed in the State.

Such development has come with a price. Fragmentation of the surrounding landscape by drilling pads and access roads is widespread. Pipeline corridors also fragment habitat, and have the potential to damage streams at pipeline/stream crossings. The potential for groundwater, surface water and air pollution at drilling sites is of constant concern.

Agricultural land uses can also have dramatic affects on aquatic environments, particularly where there is no vegetative buffer between agricultural areas and a stream. Although this use is limited in the Upper Manistee River system, the affects of agriculture can be seen in some areas. Tillage of soil increases erosion and sediment inputs to streams. These sediments bury gravel and cobbles critical to reproduction and survival of many fish species. Riparian vegetation is often removed, resulting in loss of habitat, warming of water temperatures and reduced filtering of contaminants.

Wetlands, important as spawning and living areas for many species and important to the water quality of the system, were frequently drained to increase land available for tillage. Water withdrawal for irrigation can reduce summer base flows and negatively impact the river.

Land development for residential and other “urban” uses also has dramatic impacts on the aquatic environment. These impacts are increasing with the recent trends of increased development of northern Michigan waterfront properties. Sediment from construction activities, removal of streamside vegetation, filling of wetland and floodplain areas, increase in impervious land area adjacent to streams resulting in warmer temperatures, increased pollutant loads and less stable flows, and discharge of pollutants from wastewater treatment plants and individual wastewater systems such as septic tank/drain fields are all examples of the documented or potential effects of urbanization on the Upper Manistee River system.

Part of the Upper Manistee's value is evident in the way it has influenced people's lifestyles since early times. Native Americans depended on the river for transportation, food, and water. Early settlers depended on it in much the same way, as it later became the sole means of transporting logs to the sawmills and thereby was very important to early residents' way of life. Today the river and its adjoining lands fill different purposes, but they are still important to everyday life. The river and lands are a recreational and commercial resource for many people. Current local culture has partly been determined by the need to meet the demands of users of the river and the surrounding resources. These demands continue to have an influence on the river corridor.

F. BIOLOGICAL COMMUNITIES

1. ORIGINAL FISH COMMUNITIES

An accurate, comprehensive description of the fish community at the time of European settlement is not available. Michigan grayling were abundant in the Upper Manistee River prior to European settlement. Suckers, shiners, northern pike, and whitefish are the only other fish mentioned by early observers as associated with grayling in Michigan streams. Other species present, but not easily observed, would have been blacknose & longnose dace, sculpin, and chestnut and brook lamprey. Potamodromous species (fish that spawn in fresh water rivers but spend their adult lives in fresh water lakes) including lake sturgeon, lake trout, lake and round whitefish, burbot, walleye, and troutperch inhabited the river seasonally.

The Boardman River was thought to be the most southerly stream that native brook trout inhabited. However, brook trout may have been native to the Manistee River watershed. A newspaper article in the Manistee Times dated Sept. 11, 1869 by George C. Depres cited that a Mr. Ruggles and other gentlemen took a large “mess” of “speckled brook trout” from Pine Creek (a Manistee River tributary downstream of the planning area). The change of the Manistee River from grayling to a trout river was attributed to competition, over-harvest, and habitat destruction during the logging era.

The first accurate fish surveys in the Manistee River were not conducted until 1958. These were done in conjunction with a lamprey study in the upper river. Thirty species of fish, including three lamprey species, were collected from 30 sampling stations in the mainstream and tributaries. Most of the sampling stations were in the Upper Manistee River, above the Smithville area on the mainstream, and tributaries. By the time the survey was conducted, the grayling, which is now extinct statewide, had been extirpated from the watershed.

2. PRESENT FISH COMMUNITIES

European settlement caused dramatic changes in the Manistee River and its watershed, many of which changed the river's fish communities. Logging, dams, agricultural and urban land use, point-source discharges, lake-level controls and introduction of exotic species, both intentional and unintentional, have all had an impact on the river system and therefore on its fish communities.

The watershed is now thought to contain 80 fish species (Table 2). Species distributions vary from one small inland lake to watershed-wide. One species has been extirpated and some are rare or threatened, while most native species are still present. Two species, the lake sturgeon and pugnose shiner, are considered "threatened" by the State of Michigan. Thirteen non-native fish species have been introduced into the watershed (Table 3). These include unintentional and intentional introductions and migrations. Many, such as sea lamprey, coho and chinook salmon in the lower river, and rainbow and brown trout, have had a profound impact on the biological and social aspects on the river and its use.

A brief description of the existing fish populations by river segment follows:

Headwaters to M-72

The best trout populations in the mainstream exist in this stretch, including good self-sustaining populations of brook and brown trout, with the former predominating. Fish habitat has partially recovered from the turn of century logging disturbances, in part due to efforts by the Upper Manistee River Restoration Committee, a partnership of public and private interests. Trout population estimates continue to show annual increases in recent years, including a nearly 21% increase in trout per acre from 1992 to 1993. This segment is classified as a "Blue Ribbon" trout stream.

M-72 to Smithville

This reach has fair to good populations of large brown trout, large numbers of young-of-the-year brook trout and a few rainbow trout in riffle areas. These populations are sustained with hatchery fish. There are also the beginnings of a coolwater community of walleye, smallmouth bass, redhorse, and white suckers downstream of Smithville. MDNR Fisheries Division, Manistee River Association, Upper Manistee River Association, and other private parties stock part of this stretch and downstream. Chestnut lamprey are abundant in this segment.

North Branch Manistee

This stream has good self-sustaining brook trout populations, with some brown trout present. Chestnut lamprey are abundant in the lower third of the segment. An occasional "tiger trout", which is a natural cross of a brook and brown trout, is reported by anglers. The area from Mecum Road to the mouth is classified as a "Blue Ribbon" trout stream.

Tributaries

Almost all tributaries are designated trout streams. Some tributaries are good fisheries, including Goose Creek (brook trout), Big Cannon Creek (brook and brown trout), Little Cannon Creek (brook trout), and Hopkins Creek (brook and brown trout). These are all naturally produced and self-sustaining fisheries.

3. MAMMALS

Beaver, mink, muskrat, raccoon, otter, cottontail rabbits, snowshoe hare and fox and red squirrels are some of the mammal species associated with the Upper Manistee River watershed. All of these species are present in moderate to very abundant populations. White-tailed deer are abundant, and are seasonally dependent upon the mainstream and tributary corridors and headwater areas in the watershed. Deer use these sites for yarding purposes when severe winters force them to abandon the uplands. Black bear, bobcat, fox and coyotes can also be found in areas of the watershed, but are seldom observed.

Two species of mammals that frequent the watershed are listed in the Michigan Natural Features Inventory (Table 4). The pine marten is considered "threatened" by the State of Michigan, while the woodland vole is a species of "special concern."

4. BIRDS

A large variety of waterfowl nest in the watershed. The watershed is within the Mississippi Flyway used by migrating ducks and geese.

A review of the Michigan Natural Features Inventory identified eight species of birds listed as endangered, threatened or of special concern that may frequent the area. They include the bald eagle (threatened), common loon (threatened), king rail (endangered), Kirtland's warbler (endangered), loggerhead shrike (endangered), northern harrier (special concern), osprey (threatened), and red shouldered hawk (threatened). The bald eagle, loon, king rail, osprey, and red shouldered hawk are intrinsically associated with the watershed, either for habitat or feeding areas. Significant great blue heron rookeries exist within the watershed. One other scarce bird species present in the area is the pileated woodpecker, a species that thrives in mature forests.

5. AMPHIBIANS AND REPTILES

Thirty-eight species of amphibians and reptiles have been documented in the Manistee River system or its associated wetlands (Table 5). Three species are currently listed as of "special concern" in the Michigan Natural Features Inventory. They are the Massasauga rattlesnake, spotted turtle, and wood turtle. The wood turtle is of special interest in that its nesting sites are sandy stream banks and it lives in river corridors. Breeding areas are of prime importance since nesting habitat may be reduced by river rehabilitation projects that stabilize and re-vegetate eroding stream banks. Studies on the Au Sable River (Lower Peninsula) and Indian River (Upper Peninsula) on the nesting requirements of the wood turtle indicate the wood turtle is fairly selective in choosing a nesting site, preferring gentle sloping south and west facing banks. Studies in Minnesota and Wisconsin have identified commercial and casual collection as the major cause of wood turtle decline. This is partly due to the turtles' apparent lack of fear of humans, allowing canoeists and others to easily approach and capture individuals. On-going studies also indicate that nest predation by raccoons may have a major effect on population levels.

6. AQUATIC INVERTEBRATES

There are at least two areas that have unusual aquatic insect communities, in addition to the abundant invertebrate populations in the headwaters. These are areas that have significant hatches of the "Michigan caddis", which is actually a mayfly (Genus *Hexagenia*) and not a caddis fly

(Genus *Tricoptera*). Excellent hatches of *Hexagenia l.* are found around Cameron Bridge and below Rainbow Jim's landing. In addition, they are found in lesser numbers throughout the area from Cameron Bridge to the Hodenpyl Dam backwaters, downstream of the planning area.

No comprehensive invertebrate studies have been done in the Manistee River watershed. Invertebrates often are sensitive indicators of habitat problems that are affecting fish and other aquatic life. Three macroinvertebrate studies have been conducted in the watershed, by Michigan Department of Environmental Quality (DEQ). In 1985, DEQ Surface Water Quality Division (SWQD) sampled macroinvertebrates above and below Flowing Well Trout Farm on the North Branch of the Manistee River. They found similar benthic communities above and below this private fish hatchery.

No species of mussels are currently listed for this area in the Michigan Natural Features Inventory (Table 4). However, no definitive studies have been conducted in the watershed and a complete inventory of the mussel species present would be beneficial.

7. PEST SPECIES

Pest species are defined here as those species that have been introduced, either accidentally or intentionally, or are exceptionally damaging to economic values, and that pose a significant threat to native species or their habitat. Most species do not pose any threat unless they are present in high densities.

The only fish pest species that is abundant in the Upper Manistee River, its impoundments, tributaries, or natural lakes is the chestnut lamprey. This parasite is abundant in the mainstream from Co. Road 612 to Sharon Bridge and is very abundant in the mainstream downstream of Sharon Bridge. While chestnut lamprey do cause mortalities to trout, the mortality is not significant.

A pest species of mollusk, the zebra mussel, has invaded the Tippy Dam pond and river downstream.

Rusty crayfish are in the Manistee River system. The "Rusty" is an exotic species, probably introduced by bait dealers and anglers. It is an extremely aggressive crayfish, even known to attack swimmers' toes, and has often replaced native species where introduced.

There are two known pest plant species in the Manistee River system, purple loosestrife and Eurasian milfoil. Eurasian milfoil is present in several of the lakes in the watershed.

Several terrestrial pest species are present, among them gypsy moth, forest tent caterpillar, spruce budworm, and jackpine budworm. None are present in high enough densities to be a problem except the gypsy moth, which can cause severe tree mortality in forested areas. The gypsy moth itself does not kill the tree, but lowers its resistance to other diseases and parasites, especially in oaks on poorer sites.

Other natural features, animals and plants that occur in the Manistee River area are listed in Table 4.

G. HYDROLOGY AND CHANNEL MORPHOLOGY

1. ANNUAL STREAM FLOWS

Draining an area of 590 square miles, the Upper Manistee River has average discharge rates at the following United States Geological Survey (USGS) Manistee gauge stations: Mancelona Bridge (Otsego County)-18 cfs; County Road 612 (Crawford County)-116 cfs; CCC Bridge (Kalkaska County)-256 cfs; Sharon (Kalkaska County)-336 cfs; and Sherman (Wexford County)-838 cfs.

2. FLOW STABILITY

Seasonal flow stability can be critical to support balanced and diverse fish communities. It is also a determining factor in ecological and evolutionary processes in streams and has been positively correlated to fish abundance, growth, survival, and reproduction.

The Manistee River mainstream and the Au Sable River are said to have the most stable seasonal flows of any streams in the country. The extreme stability of the mainstream of the Manistee River is a reflection of the geology and soils in the watershed.

River systems such as the Upper Manistee also have very stable daily flows due to the soil types and buffering wetlands present in the watershed. Human-induced factors such as dam operations and some lake-level control structure operations can cause significant daily flow fluctuations. These daily fluctuations can destabilize banks, create abnormally large moving sediment bedloads, disrupt habitat, strand organisms, and interfere with recreational uses of the river. Aquatic production and diversity are profoundly reduced by such daily fluctuations.

One active lake level control structure in the watershed is located on Lake Margrethe. This structure is operated seasonally by the Crawford County Road Commission. When water in the lake is above the target level, flows are rapidly increased to bring the lake level down and when the lake water level is below the target level, flows are reduced.

3. CHANNEL GRADIENT

River gradient is one of the main controlling influences on the river channel. Steeper gradients allow faster water flows with accompanying changes in depth, width, channel meandering, and sediment transport.

The average gradient of the Upper Manistee River mainstream is four feet per mile. Naturally, some portions of the river are steeper than average while others are more gradual. These different gradient areas create different types of channel, and hence different kinds of habitat for fish and other aquatic life. Typical channel patterns in relation to gradient are listed below. In these descriptions, hydraulic diversity refers to the variety of water velocities and depths found in the river. The best river habitat offers such variety to support various life functions of various species.

<u>Gradient Class</u>	<u>Channel Characteristics</u>
0.0 - 2.9 feet/mile	Mostly run habitat with low hydraulic diversity
3.0 - 4.9 feet/mile	Some riffles with modest hydraulic diversity
5.0 - 9.9 feet/mile	Riffle-pool sequences with good hydraulic diversity
10.0 - 69.9 feet/mile	Well established, regular riffle-pool sequences with excellent hydraulic diversity
70.0 - 149.9 feet/mile	Chute and pool habitats with fair hydraulic diversity
> 150 feet/mile	Falls and rapids with poor hydraulic diversity.

4. STREAM CHARACTERISTICS BY SEGMENT

Discharge rates, gradient and other characteristics of various segments of the river channel are as follows:

Headwaters to M-72

From its source to the confluence of Frenchman's Creek, the Manistee River follows a shallow, winding, woody-cover filled course. River discharge at Mancelona Bridge is 17.6 cfs and the gradient is 5.9 ft/mi. This section is characterized by areas of shallow water and a channel with abundant vegetation and woody debris.

From Frenchman's Creek to the M-72 Bridge, the flow and depth increase and the channel has less woody debris. River discharge at County Road 612 is 116 cfs and gradient is 2.1 ft/mi.

M-72 to Wexford/Missaukee County Line

Between the M-72 Bridge and Sharon the channel widens and in most areas is practically lacking the large woody debris that provides trout cover and insect habitat. River discharge at CCC Bridge is 256 cfs. Gradient ranges from 2.2 to 9.8 ft/mi. in this stretch. This section has many short, relatively shallow, fast riffles.

The North Branch of the Manistee River enters the mainstream at Sharon, resulting in a larger, deeper channel. River discharge at Sharon is 336 cfs.

North Branch of the Manistee River

The North Branch follows a slow, winding course through open marshlands, with beaver dams, dense overhanging vegetation, and partly submerged woody debris. The North Branch has a discharge rate of 26.4 cfs.

H. VEGETATION, SOILS AND LAND USE PATTERNS

The historical vegetative cover of the watershed was predominantly pine forest and hardwood forest, with wetlands intermixed. The current landscape is predominantly coniferous, deciduous, or wetland forest (54 percent), agricultural land (39.03 percent) and a few urban areas (3.29 percent). Common tree species in areas with loamy soils include northern white cedar, balsam fir, red maple, and basswood. In the higher, sandy areas, red pine, jack pine and oak dominate.

Current land use patterns in the watershed are approximately as follows:

Urban and suburban	3.29%
Agricultural	39.03%
Range land	1.71%
Coniferous forest	12.18%
Deciduous forest	29.28%
Wetlands (forested & non-forested)	12.83%
Lakes and streams	1.68%

While thirty-nine percent of the area is listed as agricultural land, little of this is tilled cropland. The majority is pasture, fruit orchards, or Christmas tree plantations.

The majority of the soils in the watershed, especially along the mainstream, are deep sands of the Kalkaska-Rubicon-Grayling series, which are very well drained, rapidly permeable soils.

Soils of the watershed include the following (percentages are approximate):

Clayey	7.9%
Loamy/organic/sand/gravel/sandy	41.4%
Sandy	19.4%
Wet/clayey/loamy/sandy/organic	29.6%
Inland lakes and streams	1.7%

I. LAND OWNERSHIP

The State of Michigan MDNR has extensive land ownership in the Upper Manistee River corridor. Table 6 reflects the land ownership by county within 400 feet on either side of the mainstream and tributaries. A total of 52.2 percent of the corridor lands are in public ownership. In 1994, a significant transfer of riparian and other lands from Consumers Energy to the MDNR resulted from a settlement between the two parties related to the operations of the Consumers Energy Ludington Pumped Storage Facility. Consumers Energy land ownership is now primarily project lands associated with Tippy and Hodenpyl Dams downstream of the planning area.

A major land use in the Upper Manistee watershed is the Hanson Military Reserve, a training area for National Guard Units nationwide. This area on the east side of the mainstream extends from M-72 downstream to CCC Bridge. Little military land actually abuts the Manistee River mainstream, but most of the Portage Creek stream frontage is within the reserve.

J. RECREATIONAL USES

Fishing and canoeing are two of the most popular recreational uses on the Upper Manistee River system. These two activities also generate user conflicts in some areas at certain times of the year.

1. CANOEING

Most of the Upper Manistee River mainstream is canoeable. Headwater segments and tributaries are not generally suitable for canoeing due to brush, logjams, and beaver dams.

Although the Manistee River near Deward is large enough for canoeing, canoeing is most popular from Cameron Bridge to Sharon. An additional area of high canoe use is from Smithville to U.S. 131 Bridge downstream of the planning area. Several canoe liveries are located in the Upper Manistee River area.

Canoe trip lengths and conditions for various segments of the system are as follows (much of this information is taken from "Canoeing Michigan Rivers" by Jerry Dennis and Craig Date, 1986 Friede Publications):

MANISTEE RIVER

Deward to M-72 - 14.5 miles, approximately 5 ½ to 7 hours

The river averages 30-50 feet wide and one to three feet deep in this section, with occasional deadfalls present, and with "spreads" areas of braided channels located between Cameron Bridge and County Road 612 and between County Road 612 and M-72. Access is at unmarked trails in the Deward area, Cameron Bridge, County Road 612, the Upper Manistee River State Forest Campground and the State Forest Campground at M-72. The upper sections can be challenging to novice canoeists due to deadfalls, sweepers and a moderate current. Most of the residential development in this area is downstream of County Road 612.

M-72 to CCC Bridge – 14 miles, approximately 4-5 hours

The river averages 40-80 feet wide and one to four feet deep with occasional deeper holes. Access is limited in this stretch due to the great amount of private land and no road/stream crossings. Denser development in the form of cottages is seen near the upper and lower sections of this stretch. Current is slow to moderate in this area, with an occasional "sweeper" to keep paddlers alert.

CCC Bridge to Lower Sharon Bridge – 9.5 miles, approximately 2 ½ to 3 ½ hours

The upper and lower thirds of this section provide an excellent float, with less development and a swifter current in this section than in the previous section. The river still averages 40-80 feet, but with more volume and therefore deeper holes. Again, easy access is limited to the start and end points of this section. The swifter current, high forested banks in some areas and less noticeable development make this one of the nicer sections of the river for canoeing.

Lower Sharon Bridge to M-66 – 9.5 miles, approximately 2 ½ to 3 ½ hours

Below Sharon the river increases in size due to the influence of the North Branch of the Manistee, and slows and widens somewhat, averaging 60-90 feet with some pools up to 10 feet deep. Much of the river corridor consists of floodplain/wetland areas.

M-66 to Old US -131 State Forest Campground (downstream of the planning area), 25 miles, approximately 6-8 hours

A very scenic stretch of river, this section has a fairly swift current and a few riffle areas in the first few miles. However, the current soon slows and the river becomes deeper and slower, and more turbid after a rain due to the heavier clay content of the surrounding soils. The latter part of this trip also features high, forested banks with relatively little development, lending a feeling of remoteness to the section. There are a few intermediate access points on this stretch at county road crossings.

2. FISHING

Trout fishing is extremely popular throughout the river system, including the smallest of tributaries (also see “**Present Fish Communities**”). At this writing, the section from M-72 to C.C.C. Bridge on the Upper Manistee River mainstream is subject to special regulations that specify “flies-only” fishing with a year-round fishing season, except that the brook and brown trout possession season runs from the last Saturday in April through October 31st. The fishing season for the remainder of the mainstream is from the last Saturday in April until September 30, with all tackle allowed. Tributary seasons are also from April to September, with slightly smaller minimum size limits for most trout. See the current Michigan DNR Inland Trout and Salmon Guide for details.

Upper portions of the Upper Manistee River mainstream and major tributaries, and all of the lesser tributaries, are wadeable. Most contain brook and brown trout.

3. OTHER RECREATIONAL ACTIVITIES

Hunting for a variety of game is popular in the watershed. Game mammals such as white-tailed deer, squirrels, snowshoe hares and cottontail rabbits are abundant in many areas. Game birds present include ruffed grouse, woodcock, a large wild turkey population and many varieties of waterfowl.

Other popular recreational activities include camping, picnicking, trapping, ORV trail riding, cross country skiing, hiking, horseback riding, bird watching and simply observing the river and its associated flora and fauna. Segments of the North Country National Scenic Trail are located in the watershed, some coinciding with the existing Shore to Shore Trail. Numerous snowmobile trails exist in the watershed.

There are numerous campgrounds and public access points throughout the river system. These are listed in Table 7.

K. DAMS AND BARRIERS

There are currently 13 known dams in the Upper Manistee River watershed, regulated under authority of Michigan's Dam Safety Part 315 of 1994 PA 451 (Table 8). Ninety percent of these have a head of five feet or less. None have a head greater than 20 feet. The storage capacity of most of these dams is very small, in the 0-10 acre-feet range.

Three relatively small dams four to six feet high were constructed by the MDNR Wildlife Division to create floodings for wildlife habitat. All of these, including Goose Creek Impoundment, Cannon Creek Flooding No. 1, and Cannon Creek Flooding No. 2 are on designated trout streams.

L. MINERAL EXTRACTION

The watershed has experienced a great deal of oil and gas activity since the 1930's. Earlier exploration and extraction activities focused on recovering oil from formations in the eastern and southern areas of the watershed. The Niagaran Reef that is present throughout the northern portion of the watershed was first developed in the late 1960's. Since 1987, there has been increased activity related to Antrim gas development, tapping relatively shallow gas reserves throughout the watershed. The potential for widespread continued Antrim gas development exists in all areas of the watershed. Gravel extraction activities are also present in the watershed.

M. WATER QUALITY

Overall surface water quality in the Upper Manistee River basin is excellent. Water quality parameters under normal conditions meet the criteria for total body contact recreation, and aquatic life. This is due in large part to the deep permeable soils of the watershed which allow precipitation to rapidly be absorbed. This leads to groundwater flows being the dominant contributor to river flow. Limited development has also helped preserve water quality.

One National Pollution Discharge Elimination System (NPDES) permit for surface water discharge of effluent (the Flowing Well Trout Farm) exists for the basin.

The Michigan Environmental Response Act, Act 307 of 1982, as amended, provides for identification, risk assessment and evaluation of sites of environmental contamination. Twenty-four such sites have been identified in the Upper Manistee River Basin (Table 9).

With good water quality in the watershed, fish populations in the river system have not been subject to any specific fish consumption advisories. All of the waters of the Upper Manistee watershed are classed as designated trout streams.

N. SPECIAL JURISDICTIONS

Numerous Federal and State laws and county, township and municipal ordinances affect the river and riparian zones. Some Federal laws and many State statutes affecting the river and its adjoining lands are administrated by the Michigan Department of Environmental Quality (MDEQ), Land and Water Management Division (LWMD) (Table 10).

1. NAVIGABILITY

Navigable Waters as Public Waters

The definition of legal navigability of Michigan streams (i.e. "public waters") is part of an ongoing controversy. Public and private rights related to water have historically been determined by the courts. A navigable water has been defined as any water which in its natural state is capable of and has been used for the purposes of commerce, travel and trade by the customary and ordinary modes of navigation. The floating of logs during the lumbering era was held to be an act of commerce. Consequently, any lake or stream used for this purpose would be considered navigable. Thus, the "log floatation test" has largely become the method of determining the "navigability" of a stream in Michigan, and therefore whether that stream is a public water.

On a navigable stream, the public has the right to float the stream, wade on the submerged soil and to fish in the stream. This right does not extend to trespass upon the private lands of abutting landowners, except that a wading angler may enter upon the upland to avoid a hazard or other impediment obstructing passage within the stream. The public should also feel secure in making a portage around any dam or other obstruction. The banks of a public stream are subject to the public easement only so far as they are necessary to exercise the right of passage and navigation. There have been periodic legislative efforts in Michigan to refine the definition of a navigable water.

Whether a stream is determined to be navigable has no bearing on whether it may be designated a Natural River. Also, designation of a stream as a Natural River has no bearing on its status as a navigable water.

None of the Upper Manistee River system has been declared non-navigable by the courts.

2. COUNTY DRAINS

County Drain Commissioners have authority to establish designated drain systems under the Michigan Drain Code (PA 40, 1956). This allows for construction or maintenance of drains, creeks, rivers, and watercourses and their branches for flood control and water management. A designated drain may be cleaned out, straightened, widened, deepened, extended, consolidated, relocated, tiled, and connected to improve flow of water. Designated drains constructed prior to January 1, 1973 are exempt from the provisions of the Inland Lakes and Streams Part and the Wetlands Protection Part of 1994 PA 451.

The only known designated county drain in the watershed, the Ham Creek Drain, is located in Bloomfield Township, Missaukee County. The relatively few drains in the Manistee River system indicate little development, limited agricultural areas, and mostly sandy soils.

Drain Commissioners are also responsible for the maintenance and operation of lake-level control structures, including the structure on Lake Margrethe in Crawford County, the headwaters of Portage Creek.

3. FEDERAL WILD AND SCENIC RIVERS

The U.S. Forest Service has studied the entire Manistee River system for possible inclusion in the Federal Wild and Scenic Rivers Act. At this time, no portions of the Upper Manistee river have been designated as Federal wild and Scenic rivers. Portions of the Lower Manistee River and Bear Creek in Manistee County and the Pine River in Wexford and Manistee counties were designated as Federal Wild and Scenic rivers under provisions of the Federal Michigan Scenic Rivers Act of 1991 (PL 102-249).

O. CITIZEN INVOLVEMENT

Many citizens groups take an active role in protecting and managing the Upper Manistee River watershed. Such groups often act in partnership with MDNR, USFS and other government agencies to work toward the improvement of the river system. Such groups include the Michigan Council of Trout Unlimited, Michigan River Guides Association, Upper Manistee River Association, Manistee River Association, George Mason Chapter of TU and the Michigan Chapter

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of Fly Fishing Federation. The non-profit Huron Pines Resource Conservation and Development Council have been instrumental in forming partnerships with many of these groups in the form of restoration committees dedicated to stabilizing eroding streambanks and improving inadequate road/stream crossings.

Many citizens took an active role in helping MDNR develop this Natural River management plan as part of the Upper Manistee River Citizens Advisory Group. Group members represented a wide range of interests such as property owners, local government, local and State-wide citizen and sporting groups, local business and interested citizens from the local area and outside the area. The knowledge and commitment of group members over a three-year planning process was invaluable in the development of recommendations for stream segments to be designated and use and development standards for both public and private lands along those segments.